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531ST ORDINARY GENERAL MEETING.

MONDAY, APRIL 15TH, 1912, at 4.30 P.M.

PROFESSOR EDWARD HULL, LL.D., F.R.S., VICE-PRESIDENT, TOOK THE CHAIR.

The Minutes of the previous Meeting were read and confirmed, and the following elections were announced :—

ASSOCIATES : The Rev. D. A. Stewart, M.A. ; G. W. Maunder, Esq.

The CHAIRMAN : I have the pleasure to introduce to the Members of the Institute the Rev. Professor Henslow, who through a long and useful life has been investigating the structure and origin of plants and animals, and will expound to you his views on one of the most mysterious of physical problems, the development of species as far as human investigation is capable of carrying us under the term of "Directivity," which for good reasons he prefers to that of Darwin under the term of "Natural Selection." If the problem is incapable of solution at the lecturer's hands, it is only because it baffles the ken of human investigation.

ADAPTATIONS IN PLANTS AND ANIMALS TO THEIR CONDITIONS OF LIFE ARE THE RESULT OF THE DIRECTIVITY OF LIFE. By the Rev. Professor G. HENSLOW, M.A., F.L.S., etc.

IN studying nature one must clearly understand what we mean by Natural Science, and what are the methods of proof at our command to establish any theory or interpretation of nature's methods of procedure. Apart from Psychology, natural science embraces: (1) the accumulation and classification of *facts* appreciable by the senses; (2) the investigation

into their correlations and causes; (3) the generalizations from them and the consequent discovery of natural laws; (4) the search for proofs of all inferences, deductions, hypotheses, etc. These must be based, first on *Induction, i.e.,* the accumulation of coincidences, all conspiring individually and collectively to establish the same *probability* as a *fact.* Secondly, whenever possible, induction must be corroborated by *Experimental Verification.*

The objects of natural science also include an investigation into all the phenomena of physical forces. But the *nature* of them, as well as the *ultimate* origin or *Final Cause* of both Matter and Force are unknowable to science.

Scientists are perfectly satisfied with inductions, or the accumulations of probabilities, in all the physical sciences, and it is my object to show that we depend largely and legitimately upon them in Biology. Thus the conviction of the truth of the doctrine of Evolution of all living beings, including man, is based both on induction and experiment. By means of these it has been incontestably and permanently established. I assume that everyone here present is a believer in Evolution, though, like myself, he may not accept Darwinism, *i.e.,* Darwin's theory of *the Origin of Species by Means of Natural Selection,* the title of his well-known work, to account for evolution.

Without transgressing the bounds within which a student of nature has wisely confined himself, namely, all that can appeal to his senses as far as observation and experiment can carry him, as well as just and logical inferences from them—my object, I say, is to show that the nearest approach to a Final Cause possible to the scientist is that we must look to *Life* alone as being endowed with the capacity of *directing* the lifeless physical forces of nature, so that they act upon the also lifeless matter, in order to compel them to form what we are justified in calling *purposeful structures, i.e.,* each of them is of some definite use to the plant or animal.

Botany and Zoology have acquired a new name, that of "Ecology." In former days the structure of plants and animals was only studied for the sake of their classification. Anatomy and Physiology were matters of independent laboratory work. Ecology brings every kind of study to bear upon the organism as it lives wild in nature. The word means "Study" at "Home," *i.e.,* the natural surroundings of the organism; just as "Economy" means the "Ordering of the House."

This new method of pursuit in Biology leads to the recognition of "Associations," all the species of which live under the same

conditions, in the case of plants, such as dry, moist, water, alpine, arctic, &c., and the first observation is that plants of no relationship whatever, but living under similar conditions, are all equally adapted to them; and that even in different continents they often assume the same forms with regard to their vegetative organs, *i.e.*, the roots, stems, and leaves; but are distinguished by their flowers and fruits, which record their right positions of classification.

This leads to the question:—Why are they alike?

The inference of a very wide induction is that the *Cause* lies in the *Direct Action* of the external conditions of life to which the plant *responds*, and the result is *Adaptations* to those conditions. Such are the consequences of the *Directivity of Life*. Lastly, I repeat, experiments verify this induction.

The conclusion is that Ecology *proves* that Evolution is the result of spontaneous adaptability to changed conditions of life. In other words *Self-Adaptation is the Origin of Species.*

The word "Directivity" is new, and does not occur in any dictionary.

We are indebted to Sir A. H. Church, F.R.S., the eminent chemist, for the use of it. He invented it for he felt a want when lecturing on the making of organic products in the laboratory. "I coined it," he writes me, "to avoid the use of force, energy, etc., when describing the parallelism between the chemist *directing* in his laboratory practice chemical *forces* in making true organic compounds, and that mysterious something which employs the same forces to make the same compounds in the plant or animal."

That mysterious "something," as far as human *observation* can carry us, is *Life*, and Life's Directivity applies to every part of an organism, from the original cell to the structure of every tissue and every organ.

When we remember that the universe contains nothing but matter and force, that the former consists of about eighty so-called elements, that *none* of these *per se* is alive or *has any spontaneous power to move;* for there must be some extraneous force to cause their motion, if matter be moving in any direction; and again that *no force can direct itself* or act upon matter *in a determined, purposeful manner;* then it becomes obvious that life cannot arise out of non-living forces or non-living matter. It is not that protoplasm creates life, but the reverse; no new protoplasm ("The physical basis of Life," as Huxley called it) is ever made except through living protoplasm, or rather by the *life in it;* since protoplasm consists of some half dozen inert elements chemically combined in certain proportions.

Sir A. H. Church only applied his term to the manufacture of some definite organic products, as indigo, madder, some sugars, etc., but it covers really the whole field of the entire structure of animals and plants, and when these change under changed conditions of life, it lies at the root of Evolution itself. Every cell implies a "purpose," which the elements C,H,O, combined to form "cellulose" could never *per se* accomplish, and when the organs of an animal or plant change, to become adapted to new uses under new conditions, nothing but directivity could effect the alteration. Thus paws of some terrestrial quadrupeds became paddles in whales, seals, and other marine mammalia; non-sensitive leaves and normally flowering branches have become tendrils sensitive to the slightest touch to enable them to be used as climbing organs.

Nothing of the sort or any adaptations exist in the mineral kingdom, though certain kinds of constant directivities prevail; thus, not only gravity but the planets' motions are expressible by mathematical formulæ. The forms of crystals are constant so far as the angles between their facets are concerned. Chemical combinations of elements are made according to fixed laws and in all cases matter moves under strictly *directed* forces; but they never change.

Now let us turn to the organic world. Animals and plants grow by means of food. This is a mixture of matter and force or energy. In the case of animals, it reaches nature's internal laboratory, where, just as a chemist mixes various substances in *his* laboratory, ferments, bile, acids, alkalies, etc., are severally supplied by secreting organs as required. The result is blood. Leaving the chemical department, this is now ready for distribution by means of the action of the engine or heart, which transmits it to every, the minutest part of the body; for if one pricks any spot with the finest needle, blood is sure to come out. We might compare the circulation of the blood to a train leaving a terminus, laden with all sorts of parcels *directed* to various stations along the line, which the train deposits on arriving at them respectively. Just so is it with the blood, for lime is deposited in larger quantity where bones are forming, as well as to the teeth. Silica or flint is conveyed to the teeth, nails and hair. The scarce mineral fluor—which is the material made into vases and ornaments of purple, yellow, and other colours in Derbyshire, known as "Blue John" or Fluorspar—is found located in the enamel of the teeth. Salt reaches the tears but does not stop at the mouth. Phosphorus is an important

ingredient in the brain; and iron gives the red colour to the blood, etc. Beside all this, the blood never stops to deposit its ingredients; as a train does its parcels. In addition it picks up Oxygen at the station called the Lungs for all the body to respire, by oxidising it, supplying warmth and energy for all the work to be done.

Lastly, as a train takes back "returned empties," so the blood brings to the lungs and discharges the waste product of Carbonic acid gas into the air.

Similar procedures take place in plants, though in a simpler way. A plant is built up of cells, and the cell-walls are composed of a substance containing only the three elements C,H,O, called "Cellulose." How could this inert vegetable matter be shaped into cells having all sorts of sizes and forms by "blind forces" without some directivity to guide them? A lump of clay might just as easily form itself into a brick, as Carbon, Hydrogen and Oxygen construct a cell. The cell-wall is not living, it is the life in the protoplasm within the cell which makes the former *secrete* the cellulose and so construct the cell.

Some writers would place the "directivity" in the *matter* of the protoplasm and consequently call it "purposive matter"; but the elements composing it are C,O,H,N,S,P, etc., but not one of these has, nor any, nor all in combination, any power *per se* to do anything. It is solely the *life* in the protoplasm which is the possessor of directivity.

But where or what is it that may be called the "centre of life." It is the nucleus within the protoplasm, whether this be bounded by a cellulose covering, or not, as in animals. The nucleus is one of the most extraordinary things in the world. Omitting many details, it looks like a chain lying loosely, but not neatly coiled, within a spherical membrane, outside of which is the protoplasm of the cell. Its first duty is to make two cells out of one. The chain divides into a definite number of pieces of the same lengths which take the form of a U. Now appear fine lines like a spindle, the ends forming two "poles," the broader part is on the "equator." Each U splits in two, forming two U's. These arrange themselves round the equator and are attached by their ends to the "meridians." Half of them glide along these lines till they reach one pole, the other half similarly reach the other pole. There they appear to exude some substance which unites the U's, end to end, so that a new chain is formed, now called the daughter nucleus. Now begins the formation of the new cell-wall right through the equator up to the old cell-wall; and thus two cells are formed.

These increase in size, till they are able to be divided in the same way. Thus a "tissue" of similar cells is made. It seems that the fine meridial lines of protoplasm remain and pass through the new cell-wall; so that *all* the cells have what is called a "protoplasm continuity," perhaps forming a sort of elementary nervous system.

How could all the preceding, and much detail is left out, be done without directivity? At first the new cells are all alike; but they soon have to acquire a variety of forms according to the plant's requirements. Under life's directivity some will elongate into spindles to make wood with thick and hard walls to support the stem, others will elongate much more, and instead of hardening the walls they become thick but remain flexible and so form the fibre of flax and tow. Other cells assume a drum shape, one over the other in a long line. Their partitions are absorbed and a long tube or "vessel" is thus made for the rapid and easy conveyance of water. To strengthen these the vertical wall of the cylinder is thickened in various ways; such as by a spiral band, just as a garden hose may have a coil of strong wire round it.

On the exterior surface of a leaf the cells are flat, for the purpose of making a skin, and if the plant grow in a very dry, hot district, as a desert, the outer surface is made very thick by forming a coat of substance somewhat akin to indiarubber. This prevents the loss of water. On the other hand, if the plant grow submerged, the skin is not wanted nor is any strong supportive tissue; so these are not formed.

Everywhere are to be seen innumerable, purposeful arrangements and the necessary structures to meet the necessities of plant life under all conditions wherever plants can grow. Without this capacity to make these adaptations, vegetable and animal life would either be extremely limited or cease to exist.

This capacity is shown by the *Response to the Conditions of Life;* so that when seeds get dispersed and find themselves in some different kind of surroundings, and germinate, the plantlets at once begin to assume new features under the "direct action of the changed condition of life," as Darwin expresses it, and so develop "acquired characters" in adaptation to their new surroundings. Thus, an inland plant may acquire the fleshiness of a maritime plant when growing near the sea in consequence of the influence of the salt. Or a sea-side plant may become quite thin-leaved if grown inland. The changes may be enough to satisfy a systematic botanist that the plant can be called

a new species. When *Arabis anchoretica* was grown at Kew, the seeds having been gathered from plants growing in crevices in high alpine rocks, and cultivated in the Kew Gardens, they became *A. alpina*.

There is, of course, nothing new in calling attention to purposeful structures; for such has been the theme of all natural theologians, whether it be Paley or Darwin. But the question is *how* have they come about? Paley drew an analogy between man's designing and God's designing, as in the well-known argument about the watch.

As long as comparatively few animals and plants, whether living or extinct, were known, they seemed to be very distinct; so that even Sedgwick argued against Evolution because in his day the several strata seemed to reveal distinct series of fossils. This led him to believe in a succession of separate creative acts.

The progress of research has revealed many groups of transitional forms, both in fossil animals and plants, often with almost insensible gradations, especially among living species. Thus Mr. G. Bentham tells us that in preparing the *Genera Plantarum* he could find no well-marked differences between any of the ninety *genera* of *Asteroideæ*, a tribe of the *Compositæ*; and every genus has one or more *species*. It is on such induction as this that Evolution is strongly supported, while Darwin argued upon the data supplied by Domesticated Plants and Animals.

Besides his theory of natural selection, upon which Darwin laid most stress, as the chief means by which Evolution or the Origin of Species was supposed to have been worked out in nature, he gave us an alternative solution, barely hinted at in the first edition, but much more strongly emphasized in the sixth and last. He said that the "direct action of the changed conditions of life" leads to "definite" or "indefinite" results, and adds "by the term 'definite' action I mean an action of such a nature that when many individuals of the same variety are exposed during several generations to any change in their physical conditions of life, all, or nearly all, the individuals are modified in the same manner. A new sub-variety would thus be produced *without* the aid of selection."

This change of view with regard to the source of Evolution was first introduced into his *Variation of Animals and Plants under Domestication*, II, pp. 271 ff., and subsequently into the sixth edition of the *Origin, etc.* As an example we read in the

first edition (p. 102): "Within a confined area, with some place in its polity not so perfectly occupied as might be, natural selection will always tend to preserve all the individuals varying in the right direction." In the sixth edition (p. 80) this passage runs as follows after the word "polity": "All the individuals varying in the right direction, though in different degrees, will tend to be preserved."

In his letter to Professor Moritz Wagner he wrote (1876): "In my opinion the greatest error which I have committed has been not allowing sufficient weight to the direct action of the environment, *i.e.*, food, climate, etc., independently of Natural Selection. . . . When I wrote the *Origin* and for some years afterwards, I could find little good evidence of the direct action of the environment; now there is a large body of evidence."*

There would seem to be no doubt that it was in consequence of his ecological investigations into the *uses* involving adaptations of structures for special purposes, *e.g.*, of climbing, insect fertilisation, etc., that led him to this important change of view.

Darwin alludes to "all the individuals (say of plant seedlings) varying alike." Such is *always* the case and none have the requisite "injurious characters"† for natural selection to eliminate. What, then, supplies its supposed use in destroying the vast majority of offspring? It is what Darwin called "fortuitous destruction." Of a million or more eggs of an oyster, Sir E. Ray Lankester tells us that perhaps one only is "lucky enough" to fall on a suitable spot whereon to grow into an oyster; all the rest are eaten by fishes, etc., or fall on unsuitable ground. It is obvious, therefore, that there can be no "fittest to survive." And if the above be true of one oyster, we are led to infer that it is true of *all*.

Yet there are varieties among oysters, *e.g.*, in the Baltic with less salt in the water the shell assumes a different form. There are also small and large varieties; presumably, therefore, they were the "definite results" of the direct action of different environments, including different kinds of food.

This alternative explanation of Darwin's has been amply established as the true one.‡ The theory of "Natural

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* *Life and Letters*, III, p. 159.

† *Origin*, etc., sixth edition, p. 64. "Injurious" means "inadaptive."

‡ I called it the TRUE DARWINISM, see *The Nineteenth Century*, Nov., 1906, p. 795.

Selection" and "Self-adaptation" are *mutually exclusive*. In fact the former has really no *facts* whereon to base it, only assumptions.

In conclusion, how do we now stand with regard to Evolution by the Directivity of Life?

1. Far more offspring are born than can possibly live. The majority perish by fortuitous destruction.
2. As long as there is no change in the environment, the species remains unchanged; the slight individual differences occurring in all organisms are of no account, as a rule, in species-making.
3. By emigration or transference to a different environment, *all* the offspring of the same kind, if any change is necessary, change accordingly; the adaptations appearing during growth to the adult stage.
4. If such changed organisms live for a sufficient number of generations under the same conditions in which their variations were evolved; then, if they be restored to the old environment or to some other new one, the variations *may* be hereditary and *mostly are* permanent; and Evolution will be thoroughly established, without the aid of Natural Selection.

Discussion.

The Rev. A. Irving, D.Sc., B.A., proposed a hearty vote of thanks to Professor Henslow for what might perhaps be considered, from the scientific side, the most important paper read before the Institute during this session. He thought it would be found to answer the criticisms of those who had attacked his views as to (*a*) the truth of Evolution as a theory (within its proper limits); (*b*) the necessity of recognising *directivity* as a factor of Evolution itself. The speaker quoted the words of Professor Henslow's paper (p. 248):—

"I assume that every one present is a believer in Evolution, though, like myself, he may not accept Darwinism, *i.e.*, Darwin's theory of the *Origin of Species by Natural Selection*, to account for Evolution."

The author of the paper had confined himself to the *strictly scientific side* of the question, and had thus placed the whole matter

in a masterly way before those who (with some knowledge of palæontology) were capable of following his arguments. He understood the Professor to use the term "man" (on p. 248) as connoting only his *physical organism*, the mere *homo*, as the crown and summit of the *fauna* of this planet, while, at the same time, recognizing that the term *man* (in the sense of Scripture and Philosophy) connoted a vast deal more, as he had himself contended in his published writings for years past.

Thought on this matter had moved on so far since Darwin's *Origin of Species by Natural Selection* appeared, that the speaker found himself in entire agreement with Professor Henslow in his statement (p. 255) that the theory of "Natural Selection" and that of "Self-adaptation" were mutually exclusive, and that to the theory of self-adaptation "Directivity" is *absolutely essential*. He further pointed out that Sir E. Ray Lankester's illustration from the multiplicity of the eggs of the oyster (p. 254) had its parallel in the plant-world in the tremendous waste of pollen of the *conifers*, which was a matter of common observation to those who lived in the heart of the pinewood country, giving rise to the phenomenon known by the natives as "sulphur-rain." In connexion with the remarks (on p. 249) on protoplasm as "the physical basis of life," the speaker reminded the meeting of Professor Burden Sanderson's remark in his Presidential Address to the British Association (Nottingham Meeting, 1893) that "in another sense *life* may be said to be the basis of protoplasm," a thesis which still holds the field.

Mr. ARTHUR W. SUTTON said: I fully appreciate the responsibility of responding to the Chairman's request that I should say a few words in reference to this most interesting paper we have just listened to.

Forty years ago I had the privilege, with my friend Mr. Martin L. Rouse, who is present to-day, of sitting under Professor Henslow when he was Professor of Botany and Geology at the Royal Agricultural College, Cirencester. Since that time the Professor, who was then master of these subjects, has been continually accumulating knowledge in the pursuit of Natural Science; my time has been spent in the study of plants themselves and their surroundings, under ordinary conditions of culture.

May I mention that it was extremely difficult in the five minutes

allowed me to offer any adequate remarks in reference to a paper which has taken more than an hour to read, and is so exhaustive in its details. I am extremely grateful to our Secretary for allowing me to revise and supplement what I said at the meeting.

Evolution. At the outset I much regret that Professor Henslow has used the term "Evolution" as descriptive of, or to denote, such modifications of plants or adaptations in plants as may be due to the change of environment.

I doubt very much whether any two persons in this meeting understand precisely the same thing by the term "Evolution," but I am quite certain that nine out of ten of those present, if not more, understand that by the word "Evolution" is meant some progress or development from a lower or more rudimentary organism to another which is higher and more complex. I have not the slightest hesitation in affirming that in no single instance among the many examples to which the Professor has called our attention by the drawings and specimens submitted to us, is there the slightest evidence that the changes he claims to be due to changed environment have resulted in any advance from a lower to a higher organism or from a relatively simple to a more complex one. If this is so, the term "Evolution," as almost universally understood, is incorrectly applied to such changes as the Professor considers have been produced by change of environment.

The word "modification," or even "mutation," although the latter has acquired another and distinctive meaning, would be more suitable and more correct.

Page 248, paragraph 1. I question whether the accumulation of coincidences is sufficient to establish any probability *as a fact*, because further "inferences, deductions, and hypotheses" may entirely alter our attitude towards these coincidences.

Page 248, paragraph 2. Professor Henslow says that "the ultimate origin or Final Cause of both Matter and Physical Force are unknowable to Science." I much prefer to take the view of A. Russel Wallace, the earlier but joint author of Darwin's theory of "Natural Selection," who most definitely asserts that Science demands the recognition, and therefore the *knowledge*, of an Intelligent Being as the Final—or rather the First—Cause of the phenomena of Physical Force. Without an initial act of creation followed also by subsequent creative acts, Wallace is unable to see

how any process of Evolution could overcome the otherwise insuperable barriers which would oppose themselves to the upward course of Evolution.

Page 248, line 18. No experiments exist which in the slightest degree prove the "Evolution" of Man or other living beings, and the "coincidences" upon which the induction rests relating to such "Evolution" of Human Beings or animals, or even of plants, give no warrant for assuming that such evolution is established "as a fact." Consequently, I do not admit that either have been "incontestably and permanently established"; and "Evolution" remains, as it has always been, an hypothesis and nothing more.

Page 248, paragraph 4. To start with the assumption that Life has been endowed with the capacity of directing the physical forces of nature is unsatisfying to our intelligence; this involves the further assumption that as there are infinite varieties of life, each one has been endowed with the capacity of directing the lifeless forces of nature so as to build up the structures of that infinite variety of plant and animal life which we observe around us. It is manifest that Life, unless itself directed, could never, through the ages which have passed, succeed in forming the varied structures of the countless forms of plant life, tree life, bird life, animal life, or marine life.

Page 249, paragraph 3. Professor Henslow says that "the inference of a very wide deduction is that the *Cause* lies in the direct action of the *external conditions of life* to which the plant responds." I would submit that if the Cause of Adaptation or Modification lies in the external conditions of life, *i.e.*, Environment, it does not lie or consist in life itself; and if this is so, this paragraph entirely contradicts the second paragraph on this page, where we are told "we must look to Life alone as being endowed with the capacity of directing the lifeless forces of nature."

Page 249, line 15. I maintain that for the word "Evolution" should be substituted "Variation or Modification of Form."

Page 249, line 17. I must deny that Self-adaptation is the "Origin of Species," for there is no evidence that any one of the many instances mentioned or of the specimens submitted, where specific difference is apparent, is the result of changed environment; for though it is so evident that plants, in some or many respects similar, have different characteristics when found growing under different con-

ditions and environments, there is no evidence whatever that they had a common origin, or that one form proceeded from the other, nor do we know which of the two may have been the earlier form. Consequently, to state that Self-adaptation is the "Origin of Species" is not founded upon any sufficient evidence, even though Self-adaptation may produce some more or less apparent modification.

Page 249, paragraph 7. The term "Directivity" is in every way a valuable one if we attribute the Directivity, not to some inherent quality of Life, but to the First Supreme Cause and Author—namely, God Himself.

Page 249, paragraph 8. Professor Henslow, after claiming Directivity as an attribute of Life, states that "no force can direct itself or act upon matter in a determined purposeful manner," and as Life endowed with Directivity would be a "Force," the Professor hereby denies to Life the very attribute which he claims for it, namely, "Directivity."

Page 250, first paragraph. I know of no evidence to prove that "in some quadrupeds paws become paddles, as in whales, seals, and other marine mammalia," and certainly no experiments have proved this. It is purely a hypothesis and nothing more.

Page 251, paragraph 4. After the observations already made I would only say that the life in the protoplasm is not the possessor of Directivity, but the subject of Directivity by God Himself, just in the same way as chemical forces are directed by the chemist in his laboratory.

Page 251, line 17. Is the Professor correct in saying that the cell wall is not living? Has it not as much life as the protoplasm within the cell when it is enabled to secrete cellulose?

Page 252, paragraph 5. The professor says that "when seeds get dispersed and find themselves in some different kind of surroundings the plantlets at once begin to assume new features." Anyone present would conclude from these words that it is the invariable result when seeds are dispersed and sown under varying conditions that the plantlets begin to assume new features. With all respect to Professor Henslow, I would absolutely deny that this is so. Although some slight modifications may occasionally be seen under changed environments, yet these acquired characteristics cannot by experiment be proved to be "permanent," *i.e.*, capable of being transmitted, or if so, then only in such a very limited degree as

entirely to disprove the statement that "Response to the conditions of Life" is, or ever has been, a sufficient cause for the origin of the innumerable species in Nature.

Page 253, paragraph 4. Professor Henslow says that "it is on such induction as this" (that the ninety genera of Asteroideæ show no well-marked differences) "that Evolution is strongly supported." I would submit that the mere fact that many forms or species closely approximate to one another is no evidence whatever of Evolution, unless we can, by experiment, observe these forms or species passing one into the other and always with an advance from a lower to a higher organism.

Page 254, paragraph 5. Professor Henslow is here arguing that Adaptation to environment, or Modification resulting therefrom—in other words, Self-adaptation—is "true Darwinism," and sufficiently accounts for the origin of species. As I have already indicated, I believe there is no evidence of any existing species or sufficiently well-defined and "permanent" variation being thus produced. Even if "Self-adaptation" could be proved in some isolated instances to have caused the appearance of new forms or distinct species, it could not possibly account for the origin of such diverse forms as the oak tree, the beech tree, the apple or pear tree, the palm tree, or the tamarisk. For what evidence, or even reasonable inference or deduction, is there to indicate that any amount of changed environment, or "finding themselves in some different kind of surroundings," could have produced any one of these from the other? If the Professor wishes us to believe that it is the power of Directivity, which he assumes that the life in the protoplasm possesses (see p. 251, line 25), which has, without any outside direction, produced such extremely diverse forms of tree life, and in an equal manner innumerable forms of plant, animal and marine life, I can only say that to my mind this is pure assumption based on totally insufficient "coincidences," and unsupported by any possible experiments.

Page 255, conclusion 4. Science does not admit that the characters acquired in response to changed environment "are mostly permanent." This can only be maintained by the assumption that plants now found growing under widely different conditions in various parts of the world, and which are distinct, though in some respects resembling each other, had a common origin, and that their

differences are due to having been "dispersed, and having found themselves in some different kind of surroundings" (p. 252, paragraph 5). Even when the points in which they differ are greater than those in which they resemble each other, we are asked to believe these are due to the "response to the conditions of life," which is really begging the question, for there is no evidence in the vast majority of cases of any common origin, or that they had ever been "dispersed" to different surroundings.

In 1909 the Cambridge Philosophical Society published a series of essays in commemoration of the centenary of Charles Darwin's birth, and of the fiftieth anniversary of the publication of *The Origin of Species*. One of these essays is by Georg Klebs, Ph.D., Professor of Botany in the University of Heidelberg, and is entitled "Influence of Environment on Plants." Speaking of modifications induced by experiments under changes of environment he says:—

"So far as the experiments justify a conclusion, it would appear that such alterations are not inherited by the offspring. Like all other variations, they appear only so long as special conditions prevail in the surroundings."

Again:—

"Two methods of experimental research may be adopted, the effect of crossing distinct species, and secondly the effect of definite factors of the environments. . . . The" (second) "method of producing constant races by the influence of special external conditions has often been employed. . . . But as regards the main question, whether constant races may be obtained by this means, the experiments cannot yet supply a definite answer."

And again:—

"During long cultivation, under conditions which vary in very different degrees . . . it is possible that sudden and special disturbance in the relations of the cell substances have a directive influence on the inner organizations of the sexual cells, so that not only inconstant, but also constant, varieties will be formed. Definite proof in support of this view has not yet been furnished, and we must admit that the question as to the cause of heredity" (*i.e.*, heredity which results in variation) "remains fundamentally as far from solution as it was in Darwin's time." Professor W. Bateson, F.R.S., also in the same volume deals with "Heredity and Variation in Modern Lights," and says as follows:—"As Samuel Butler so truly said, 'To me it

seems that the "Origin of Variations," whatever it is, is the only true "Origin of Species" and of that not one of us knows anything.'" "We must, as de Vries has shown, distinguish real, genetic variation from *fluctuational* variations, due to environmental and other accidents, which cannot be transmitted."

The only conclusion we can come to, after the most liberal allowance has been made for such slight modifications as may be traced to change of environment, is that "Science" cannot offer us any satisfying explanation as to the manner in which, or the means by which, the innumerable types of animal and plant life came into existence or attained their present forms. On the other hand, the more we study these forms of life, the more satisfying we shall find —if only we are willing—those incomparable and infinitely comprehensive words in Genesis:—

"*Let the earth bring forth grass*, the herb yielding seed *after his kind* and the fruit tree yielding fruit *after his kind* . . . ." "*Let the waters bring forth* the moving creature that hath life . . . ." "*Let the earth bring forth* the living creature *after his kind* . . . ." "*Let us make man in our image, after our likeness.* . . . ."

Mr. MARTIN L. ROUSE, M.R.A.S., said: Professor Henslow's lecture recalls the pleasant days in which Mr. Arthur Sutton and I were his students at Cirencester. His lectures then always exceeded anticipation by their fascinating interest; and to-day, after forty years, listening again to his discourse, I see the interest of its printed form more than doubled by his admirable illustrations. All the more do I regret that I cannot fall in with his final conclusions. Adaptations due to environment he has proved, and the breaking down of partitions between what were supposed to be different species in a few cases, but nothing approaching to the doctrine of evolution. That *Ranunculus aquaticus*, when he sowed it in dry earth, had all its leaves alike is a very remarkable fact, and more striking still is it that when it still grew in water another scientist was able to turn its lower brush-like leaves into well-bladed ones by chemical feeding, which overcame the dilution of the protoplasm by water. But no one ever saw the petals of this species change from white to yellow, like those of our land ranunculi or buttercups [though we have seen many a pond dry up with water ranunculi in its bed, and the seeds self sown near the edge must often remain without a water-covering, when the winter's rainfall is below the average]. Again I

was taught at Cirencester that, although common land buttercups love wet meadows, you may get rid of them completely by laying a whole meadow under water for a month or so—the time for which water meadows are flooded twice a year—yet in all our floodings, artificial and natural, no one ever knew a land buttercup turn into a water one.

That the splitting up of a leaf through peculiar environment does not readily tend to become a permanent character is evidenced by the case of the horse radish, for in the centre of a clump of horse-radishes you will sometimes find a good number of leaves resembling the frond of a simple fern with a separate segment to each principal vein. Yet, whoever saw a species of horse radish that had such leaves instead of the usual entire leaves?

But, in any case, nothing in this paper proves that the essential organs of a plant, left to natural influences alone, ever materially change.

Certain species of heath in South Africa and of epacris in Australia greatly resemble each other in foliages, as the Professor has shown us, and because, as he maintains, of the similar dry climate; but still the Australian plants all keep the five petals of their order, and the African ones their four.

An article written by Mr. Sutton for the *Gardeners' Chronicle*, after a recent tour in Palestine, upon the behaviour of the two well-known plants, *Anemone coronaria* and *Ranunculus asiaticus*, is strong evidence against evolution. They have flowers alike in shape and size, and often in colour also. But the anemone has, of course, only one floral envelope—no outer cup like the ranunculus, its leaves are much more finely cut than its rival's, and it begins to bloom three weeks earlier. They grow together at all altitudes, from the shore of the lake of Galilee to the top of Carmel, over a range of five thousand feet or more, yet they never interchange or lose one of their three distinctions: the earlier blooming plant is always the one with the single row of bright flower leaves and with the finely divided stem leaves, the later blooming plant has always both calyx and corolla and stem-leaves simply three-parted.

It was at Cirencester that I first learnt the peculiarity of the primrose in having its stamens in one flower all reaching higher than its style, and in another its style reaching higher than its stamens, and that Darwin had discovered that the stigmas of short styles fertilized from high stamens, and of high styles fertilized from short

stamens, yielded larger, stronger flowers than the stigmas of high styles fertilized from high stamens, and of course than short forms interbred.

This fact shows that the tendency of a species is to maintain an average type, and not to branch off into permanent exaggerated or stunted varieties.

Mr. DAVID HOWARD said: When we use the word evolution it is most important to be sure what we mean. Darwin was understood—rightly or wrongly—to teach that evolution was the result of accident; but if evolution is the result of law, or, as this most interesting paper suggests, of an adaptive power inherent in life, we may well argue that a law involves a lawgiver and that the power of adaptation in living tissue is a form of creative energy that requires a Creator to explain it.

The illustrations of this adaptive power are most interesting, and throw great light on many points in a most complex question. I am not a botanist, but I have had to study the formation of medicinal substances in plants. A very difficult problem—why do only a few species of cinchonæ contain quinine? What benefit does it serve in the life of the tree? Seeds grown in England in hothouses grow into healthy plants, the bark of which contains but little quinine, cuttings from these taken to the Nilghiris give trees with a rich yield. By careful selection and suitable environment bark is obtained giving over ten per cent. of the dry weight, but the quinine, much or little, does not seem to affect the health of the tree.

Mr. S. COLLETT said: Mr. Chairman, before making a brief comment upon Professor Henslow's paper, I should like, if it is not out of order, to propose that a message of sympathy be sent from this Meeting to our friend Lieut.-Col. Mackinlay, who, since his lecture before this Institute only a month ago, has undergone a very serious operation, from which, for some time, his life was almost despaired of. He is now, it is hoped, slowly recovering. And, although the Committee have doubtless sent a communication to him from themselves, I think it would be nice if a message of loving sympathy were sent him from this Meeting.

As to the paper before us, I am sure we must all feel that from many points of view it is a most masterly and interesting lecture. The only point, however, to which I wish to call brief attention is

the statement in para. 3, p. 248, that "*the conviction of the truth of the doctrine of evolution of all living beings, includimg man . . . has been incontestably and permanently established.*"

Now, sir, I confess my surprise that the Professor should have made such a statement as that. I should have thought that whatever his personal views might be he would have known that the doctrine of the evolution of man is one of the most *un*certain and *un*proved of theories ever propounded!

What is evolution? Here is what Sir Oliver Lodge says, and I suppose he is one of the greatest authorities of the day:—

"Taught by science, we learn that there has been no fall of man; there has been a rise. Through an ape-like ancestry, back through a tadpole and fish-like ancestry, away to the early beginnings of life, the origin of man is being traced."

Or, to use the words of two other modern professors, "It must be granted a primeval germ, originating it does not know how . . . some primitive protoplasts gliding in a quiet pool . . . proceeding through unthinkable millions of years . . . emerging *as man*, at a moderate estimate, half-a-million years ago!"

That is the doctrine of the evolution of man as taught by its greatest exponents!

Now the question is: Is this theory "incontestably and permanently established," as the Professor declares it to be? Let us see.

No less an authority than Professor Tyndall said: "Those who hold the doctrine of evolution are by no means ignorant of the uncertainty of their data!" While Professor J. A. Thomson, of Aberdeen University, and Professor Patrick Geddes, of Edinburgh University (to whom I have already referred)—both of them strong evolutionists—when writing an article in defence of evolution in a book recently published, entitled *Ideals of Science and Faith*, actually make this pitiable confession in answer to the question, "How man came":—"We do not know *whence* he emerged . . . nor do we know *how* man arose . . . for it must be admitted that the *factors of the evolution of man partake largely of the nature of may-be's, which have no permanent position in science.*" And an article in the *Times Literary Supplement* of June 9th, 1905, referring to a number of professors who have written on the subject of evolution said, "Never was seen such a mêlée. The humour of it is that they all claim to represent 'science.' . . . Yet

it would puzzle them to point to a theological battlefield exhibiting more uncertainty, obscurity, dissension, assumption, and fallacy than their own. For the plain truth is that, though some agree in this and that, there is not a single point in which all agree. Battling for evolution they have torn it to pieces; nothing is left —nothing at all, on their showing, save a few fragments strewn about the arena."

Therefore, sir, I, for one, hope I may be allowed to say emphatically that I do *not* believe in the theory of the evolution of man—partly on account of what I have already said, but also because (although I am aware that our evolutionist friends deny it) it is in my judgment so entirely opposed to the inspired record given to us in the Word of God as to the origin of man, viz., that "*God created man in His Own Image, in the Image of God created He him; male and female created He them*," Genesis i, 27.

Professor LANGHORNE ORCHARD wrote:

The chief merits of the paper are (in my judgment) its successful exposure of the fallacy of Darwinism and its insistence upon the directive character of "that mysterious something" called "*Life*." Life itself, and, therefore, also its directivity, are doubtless attributable to spiritual action. As we are reminded (on p. 249), our gratitude is due to the inventor of this useful word "*Directivity*"—a word which has come to stay, and is likely to soon take its place in dictionaries, a word which is welcomed by many scientists besides Bergson as standing for the true explanation of natural facts.

The author, like evolutionists generally, occasionally permits himself to make assumptions more bold than accurate. On p. 248 he says, "I assume that everyone here present is a believer in evolution." A reference to our *Transactions* may show him that he has made a mistake.

The arguments brought forward in support of evolution seem very feeble. On p. 249 occurs the startling announcement that "spontaneous adaptability to changed conditions of life" is the origin of species. If we look for some proof of this, we read (p. 252) that an inland plant grown near the sea may become fleshy, and a seaside plant grown inland may become thin-leaved; and it is seriously said that the changes may be sufficient to warrant the plant being called a new species. But if, with Buffon, we define a species as "a constant succession of individuals similar to, and

capable of reproducing, each other," the change of environment produces not a new species but a new variety only. Some years ago, at University College, I was listening to the author as he pointed out that a change of environment may modify size and form, but does *not* affect specific differences; and he gave as an instance the American cacti, which, when grown in Africa, remain of the same *species*, although modified in size and appearance. On p. 253 we learn that Mr. G. Bentham finds "no well-marked differences between any of the ninety *genera* of asteroideæ." It would be interesting to know on what system of classification that gentleman proceeds in calling such groups "*genera*," when they are obviously not so. The author quotes Darwin's opinion (p. 253) that changed conditions of life may produce a "new sub-variety." A "new *sub-variety*," however, is a different thing from a new *species;* and the cause of true science would not be advanced by calling it by the same name.

On p. 249 (paragraphs 1 and 2) we read that "plants of no relationship whatever," living in the same or similar environment tend, through the influence of the environment, to become *alike*. Is not this inconsistent with the statement that the environment has caused those great and striking *differences* which mark off species from one another? The several geological strata which, in Sedgwick's time (p. 253), revealed distinct series of fossils and distinct species which had lived side by side, makes the same revelation to-day, and tells us that Sedgwick was right in believing in a succession of separate creative acts.

We shall all, I am sure, join in thanking the able author for a most interesting paper.

Mr. W. Woods Smyth: While congratulating the Victoria Institute upon receiving a paper accepting evolution in any form, I beg to offer the following criticisms:—

(1) Professor Henslow appears to have changed his position. He used to make much of "Divine Directivity," now it is the "Directivity of Life." Any theory of directivity which goes beyond the dowry of attributes bestowed upon life at the beginning is entirely unscientific.

(2) The idea that species have originated through one or two factors alone is opposed to all the evidence we possess.

(3) When we consider the influence of artificial selection, exercised by man, in producing varieties so diverse as to resemble even different genera; and when we remember that organisms in a transition state, before they reached finished forms, were in a much more plastic state; and we then take into account that natural selection is much more potent than artificial selection; to say that natural selection exercised no influence in the production of species is absolutely untenable.

It is quite true that natural selection alone cannot produce species of organisms, but it is an important factor in their production. No more can its antitype in the spiritual realm, namely, election, of itself produce a Christian, but it is an important factor in his production.

The LECTURER, in reply to the more extended remarks set forth above, now writes:

I thank Dr. Irving especially for so cordially accepting my position. The only point he questions is my meaning of "man." As he rightly says, I intentionally confined myself to the scientific side of the problem of evolution. This asserts that man (*Homo sapiens*) rose from some line of the mammalia; such a belief is based on purely scientific inductions. But how he acquired his vastly superior mental, moral and spiritual attributes is a question which would have carried me far beyond the limits of my paper. I purposely avoided it, as it transcends the sphere of natural science.

Mr. Sutton has supplied me with a great number of questions, to which I will reply as briefly as possible. Evolution, perhaps, cannot be better defined than by the old expression of the sixties—"Descent with modification." To which may now be added, in Darwin's words, its meaning of definite results or variations, by means of a response in the organism to changed conditions of life. These may be relatively permanent or not at all.

It seems to be assumed by some persons that evolution necessarily implies progress or development from lower to higher forms or structures. This is not quite correct. Palæontology proves that, what were adult forms in earlier days are often now represented by the embryonic stages of modern beings, *e.g.*, amphibia were the "highest" vertebrates in the Coal period represented now by our newt and others. There were no frogs and toads, but the

tadpole of to-day is of a fish type, and passes into an amphibian and then a true air-breathing frog.

But what some appear not to have observed is that you cannot have "advance" without some retrogression; because every change implies new adaptations to the new conditions of life; but with these is correlated the disuse of certain organs no longer required; which consequently degenerate by atrophy, often remaining rudimentary, or they may vanish altogether. In all cases the resulting creature becomes perfectly adapted to its requirements.

Thus, parasites show a great amount of degradation, just as does an oyster. The whole of the class Monocotyledons has been evolved from aquatic Dicotyledons, and though many are now terrestrial plants, they all have retained the "degraded" characters due to an aquatic environment.

Mr. Sutton questions the value of "induction" (*i.e.*, numerous coincidences, all being independent of one another, yet equally supporting the same probability) as "proving" a statement.

But to do so in one science and not accept it in another is scarcely justifiable. Every "belief" in the revelations of geology in based on induction; as we cannot make Nature retrace her steps and prove by experiment how coal was made, how animals came successively into existence, etc., etc., yet it was partly the fossils of Patagonia which suggested evolution to Darwin.

In astronomy, no intelligent person believes that the sun rises and sets or that the earth is flat; but our "convictions" are based solely on "probabilities," but of so high an order that any alternative is now unthinkable.*

Mr. Sutton, however, accepts induction himself when he quotes Wallace's statement—"Science demands the recognition of an intelligent Creator." No one denies this. But it is impossible to *prove* (*i.e.*, by any experiment) that there is a God. The knowledge, or conviction in His existence, is based solely on induction; of course, apart from all revelation.

I am surprised that Mr. Sutton, one of our greatest cultivators, should say, "No experiments exist which in the slightest degree prove the evolution of man or other living beings."

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* A murderer is pronounced guilty almost always on circumstantial evidence, *i.e.*, induction.

Darwin based his theory of evolution almost entirely on *Variations in Animals and Plants under Domestication*—the title of his two volumes of *Data*. Surely we have but to think of the innumerable cultivated plants and domesticated animals which have been evolved from wild ones, and are now so totally different, that in many cases the original wild organism is unknown. The whole history is one long era of evolution by experiment! Take as an example, all the pigeons which have evolved from *Columba livida*. All the cabbage tribe from *Brassica oleracea*, all the wheats, maize, barley, etc., from unknown ancestors. Induction is not even required where the whole ancestry is known. Thus, too, Mr. Sutton's admirable forms of *Primula sinensis* and of cinerarias are now widely different from the original wild forms of China and the Canary Islands, while the latest addition called the "Lady," or by other names, is an approximate reversion to the wild form of the cineraria.

As to evolution of man; Nature has made many experiments since his first appearance; and has evolved many very distinct varieties all over the world. Each is well adapted to its sphere of life, as the Esquimaux to arctic conditions, and the Negro to tropical countries. Surely no one will maintain that each race has been specially created.

I cannot help thinking that Mr. Sutton has entertained some mistaken idea of what evolution really is. I repeat, it is nothing more than "descent with modification," sometimes "advancing," as often "degenerating," in various directions.

Whether the changes be called a variety, species, or genus, is just as the systematist chooses to call them. Thus Babington recognized thirty-two British *species* of willows. Bentham groups them under fifteen. Mr. Sutton says there are infinite varieties of "life," using this term to mean "living beings." But I use the word in its *abstract* sense; that is to say, as that which, by its phenomena, indicates a "living being." In this sense there is only one kind of life common to all. He says, "Life itself must be directed," but why may not the life of a plant be *endowed with directivity* by the Creator? A man constructs a watch and "empowers" it with directivity to tell you the time of itself, without the presence of the watchmaker; while in all manufactories the machinery turns out the completed article "designed" by the artificer without his immediate aid.

Similarly in giving rise to new beings in *adaptation* to new requirements, the life in the organism directs the *forces* within it to so arrange *matter* to build up new structures as they are wanted. The directivity of life is, therefore, seen in the very existence of new purposeful structures.

I chose as a simple illustration *Ranunculus aquatilis* and *proved* (1) that the dissected type of submerged leaves was due to water as the direct *cause*; (2) that when the seeds are sown on land that *specific character* is retained by heredity.

That this species was descended from a terrestrial form, and not *vice versâ*, I showed (1) by induction; as many other cases are known where the great majority of the allied plants are terrestrial, the aquatic one being the exception; (2) that the aquatic character is retained on land: a feature which none of the land plants show. Mr. Sutton questions the statement that if the *cause* of change lies in the direct action of the external conditions of life to which the organism responds, "it does not lie or consist in life itself." Certainly it does not, what lies in life is the "power to respond" to external stimuli. Life does not *initiate* a change, until such is wanted in consequence of a change in the external conditions of the being, to which it *must* adapt itself or it will perish.

He adds: I maintain that for the word "evolution" should be substituted "variation or modification of force." I have already observed that variation or descent with modification is exactly how evolution was often described in the sixties; but "evolution" was adopted instead. It only means "a rolling over." If "self adaptation" is not the "origin of species," how did any variation arise at all? It is only a question of degree from the "more or less apparent modification" to the most distinct species or genus.

Scientifically distinguished, directivity is a *quality of life;* as philosophically described, it is an attribute of God; just as in olden days, as man designs and makes a watch, so God was supposed to have designed and made a man.

Evolution only places God's power *within* the secondary agent *life*, instead of somewhere *outside*. *Life* must be carefully distinguished from *force*. No known force is alive; just as no matter composed of carbon, hydrogen, oxygen, and nitrogen, etc., is alive. Protoplasm is the only exceptional "matter" with its all-important "nucleus," which is *endowed* with life, but its material

elements are not alive. The cell-wall is certainly *not* alive, it is a carbonaceous excretion produced by, and on the surface of, the living protoplasm within the cell. It is allied to starch and sugar, etc.

If Mr. Sutton will do me the honour of reading my *Heredity of acquired Characters in Plants* (1908, Murray), he will find most of his queries answered. If not there they will be found in my two volumes in the *International Scientific Series, Origin of Floral Structures* (1888) and *Origin of Plant Structures* (1895, Kegan Paul and Co.). Space will not let me add more, but I would observe that neither Klebs nor Bateson mentions any experiments to substantiate his statements; many will be found in my books. Mr. Rouse alludes to the fact that while land plants can change their foliage in water, the flowers, as a rule, do not change proportionally or at all. This is true, for the external conditions of life do not so affect the flowers as they do the *soma*. Nevertheless, great degenerations *are* to be seen in many, *e.g.*, the loss of the *yellow* in the corollas of the water crowfoot. Much degeneration is seen in the flowers of all the *Haloragea*, etc.

Flooding a field is not Nature's method of encouraging adaptations. It is, as far as we can see, done by degrees. It must begin with the *seeds* in moisture; not by such a destructive method as he describes.

Mr. D. Howard observes that law requires a law-giver; so as directivity expresses the fact that new structures imply purpose, purpose implies mind, and mind means God.

That various species of the same kind, cinchona, etc., as well as other plants, yield different amounts of the same product is of frequent occurrence. Thus strong scents, alkaloids, etc., vary in quality according to the environment. It is well known that dry places especially favour these productions rather than the reverse; tea has more tannin on the hills, etc. It is all the same thing, viz., the results of response to the conditions of life.

As to Mr. Collett's question: who doubts my correctness in saying evolution is a "proved" doctrine. He refers to Sir Oliver Lodge and Tyndall, neither of whom is a biologist! The writer says he does not believe in the evolution of man, and, like Mr. Sutton, would refer to Gen. i, 27, as refuting it.

I will, therefore, in my turn, go to our greatest Assyrian and Hebrew scholar, Rev. Dr. Sayce, Professor of Assyriology. He tells

us in his analysis of every verse in Gen. i, ff., that, in the first place, the first chapter is an adaptation from an Assyrian cosmogony, but, "while the latter is grossly polytheistic, the former is uncompromisingly monotheistic." The one begins with frank materialism, in the other all is referred to the One omnipotent and all-good God.*

In 1884 I published a work entitled *Christian Beliefs Reconsidered in the Light of Modern Thought*, in which I gave the Babylonish Cosmogony discovered by the late Mr. G. Smith, and compared the tablets with Gen. i, showing the agreements and points of difference. Sayce says the former was a comparatively late production of the materialistic Philosophic age.† The second account, in Gen. ii, is an earlier one. The two, therefore, in Genesis are monotheistic compilations or adaptations from the far more ancient Babylonian cosmogonies.

With regard to the creation of man, Professor Sayce writes: "It was in Semitic Babylonia that the gods were first conceived in human form. From the outset, the deities of the Babylonian Semites were human. They were represented as men and women, being under a supreme lord, Bel or Baal, whose court resembled that of his vicegerent, the human king, on earth. . . . This conception of the gods in human form involved the converse belief that men were divine; they were, accordingly, held to have been made in the likeness of the gods—with the same physical features, and the same mental and moral attributes—and the king himself was deified,"‡ just as, I may add, is the Emperor of Japan to-day.

Professor Orchard makes much the same criticisms as the preceding writers, to which I have already replied. As to varieties and species, I repeat there is *no* absolute distinction between them. Darwin called the former "incipient species"; they really signify the fact that less alteration was required to adapt them to changed conditions.

I unwisely, it appears, assumed that after more than forty years *all* members of the Victoria Institute would have come to accept evolution; but my critics reproduce, almost *verbatim*, what I

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* *Expository Times*, vol. xix, p. 137.
† *The Religions of Ancient Egypt and Babylonia*, p. 387.
‡ *Expository Times*, vol. xix, p. 262.

received, as the only evolutionist present in 1868, when on the Council of the Institute. Mr. Orchard gives a hint *why* evolution has failed in the Institute, if one may judge from the following sentence:—"The several geological strata which, in Sedgwick's time, revealed distinct series of fossils, . . . makes the same revelation to-day, and tells us that Sedgwick was right in believing in a succession of separate creative acts." This clearly shows that Mr. Orchard is not aware of the many gaps in palæontology and in living organisms being filled up, as in the mammalia, shells, and early plants, etc., all strongly corroborating evolution.

Mr. Woods Smyth says, I "used to make much of 'Divine Directivity.'" I have no recollection of ever having referred directivity to any other source than *life*, for I have always treated it from a *scientific*, *not* philosophic or *theological* standpoint.

I am not aware "that species have originated through one or two factors alone." The external conditions include *all* the factors, such as light, heat, moisture, drought, soils, etc. These act on the entirety of the plant—the *total* result is adaptation to these.

"Selection" produces "Nothing"; neither artificial nor natural. Man only *isolates* a variety which Nature has produced. In Nature, a variety A lives, and B dies, because it dies a natural death or is killed. Natural selection did not *produce* A. My opinion is that *Isolation* not *Selection* is the important factor, because it saves the variety from the struggle for existence, which is detrimental to health and development, and leaves it to grow to maturity in peace, just as man endeavours to raise new varieties under cultivation.

I may be wrong, but it gives me the impression that my critics generally have not acquired their knowledge first hand from Nature herself. Unless this is done, and the student does so on *ecological* lines, little progress can be expected. As Galileo said that the earth moved for all his "questioning,"* so I venture to add evolution is a long since proven fact, notwithstanding my opponents.

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* "Tortures."